

Entrepreneurial intentions of engineering students

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Abstract: Promoting entrepreneurship is a key opportunity in the current environment, and engineering have recognized this criticism by including in their curricula basic financial disciplines. Given the current economic situation, provide the future engineer with concepts and techniques to move from knowledge to action, can improve the value perception of entrepreneurship as an alternative to employability on behalf of others. The aim of this paper is to present the preliminary results of the ENGEmpreende survey developed to measure the perceived attitudes and values of entrepreneurship by engineering students. Our sample involves 387 students of engineering courses from University of Minho with no experience in entrepreneurial courses, divided into undergraduate (78.55%) or master's degree students in engineering (21.45%). Portuguese engineering students report good levels of thoughts about entrepreneurship. Our study also found that their entrepreneurship predisposition has dependency relationships with gender, thoughts about entrepreneurship and entrepreneurial activities. The results of the perceived image of the entrepreneur suggest that students recognize the positive image of the entrepreneur in society, but have doubts about what is best: entrepreneur or employee in a large company? As perceived barriers, engineering students perceive as difficult to find a business idea or access to bank loans. Students' perceived skills and competence suggest a perceived high adaptability, perseverance, technical confidence and orientation to results. The results of ENGEmpreende survey give an additional contribution to the theme of engineering entrepreneurship intentions through the identification of entrepreneurship predisposition, attitude to self-employment, entrepreneurial image, barriers to entrepreneurship, risk perception and technical confidence. We identified differences explained by factors such gender and thoughts about entrepreneurship.

Keywords: Entrepreneurship; entrepreneurial behavior; entrepreneurial intentions; engineering students

1. Introduction

Nowadays it is recognized the importance of the entrepreneur's role in society. According to Heertje (1982) "in order to solve the many problems of today both in the private and the public sectors, entrepreneurial activity on a large scale, based on a sensitive and innovative attitude, guided by a broad concept of welfare, is needed even more than before." Entrepreneurs are held responsible for economic development, by introducing and implementing innovative ideas. These ideas include product innovation, process innovation, market innovation and organizational innovations. The implementation, launched by entrepreneurs, of these new ideas allow to the generation of new products or services to satisfy new customer needs and to create new companies. Those new companies generate economic growth and supply new jobs for the working population (Van Praag 1999). As Wong, Ho and Autio (2005) state "that small businesses and newly formed firms create a substantial number of new jobs, with some studies showing that small and new firms are the source for the majority of new jobs created".

Many researchers have studied entrepreneurship including the identification and study of explanatory factors for entrepreneurial behavior. In the literature of psychology, it has been demonstrated the explanatory power of intention as an important predictor of behavior. Understanding the formation of intention to undertake is important for the comprehension of entrepreneurial behavior. Entrepreneurial intention can be seen as a precise predictor of planned behavior towards starting a new business.

Given the current economic situation in Portugal, where the typical entrepreneur does not have higher education and the unemployment rate in individuals holding higher education grew 170% in 10 years (INE 2012), provide the future engineer of concepts and techniques to move from knowledge to action, can improve the value perception of entrepreneurship as an alternative to employability on behalf of others. A recent study confirms a new generation of Portuguese entrepreneurs with higher qualifications (LINI 2009). In this context, it is opportune to examine the intentions of entrepreneurship of Portuguese university students, particularly at the level of engineering courses with no previous experience on entrepreneurship courses.

The paper is structured as follows. Section 2 presents the conceptual background of entrepreneurship behavior and analyses the existing trends in entrepreneurship education. In the Section 4 is presented the results of survey to engineering students to explore their attitudes and perceptions related to the concept of entrepreneurship. Finally, in Section 5, are presented main conclusions.

2. Entrepreneurship intention: some insights

Entrepreneurship is a critical factor in fostering innovation, creating jobs and economic development of a country. Many countries have put policy priority on supporting entrepreneurship, but as Drucker (2006) said "entrepreneurship is neither a science nor an art. It's a practice". The concept of entrepreneurship is a multifaceted concept and can manifest in many different ways, which makes difficult their definition. Still, it is possible to conclude that its origin lies in the recognition of an opportunity or a need. According to D' Este *et al* (2012) the entrepreneurship literature sets entrepreneurialism as being concerned with the discovery, evaluation and exploitation of profitable opportunities, and points to a number of extensions to inform theory and empirical analysis.

For the identification and study of explanatory factors for entrepreneurial behavior, the characteristics of the individual, and the existence of market opportunity and technology, are presented as the most significant. Previous studies have shown that the profile of the entrepreneur depends primarily on motivational factors, with emphasis on personal fulfillment, the potential of new technologies, business opportunity and the desire for independence. However, there are other psychological factors that must also be taken into account, some with greater impact than others, notably the need for achievement, the self- efficacy, the propensity to innovate, the ability to share, the leadership, the confidence, the risk-taking, the ability to make decisions, the humility and the ability to make sacrifices.

Laspita *et al* (2012) argue that the exposition to a family business can propensity offspring's entrepreneurial intentions by increasing their perceptions that self-employment is a meaningful career option and it is possible to obtain highest entrepreneurial rents, i.e. the entrepreneurial intentions can be influenced by genetic factors. Besides, people may have genetics tendencies that make them more sensitive to environmental motivations representing entrepreneurial opportunities.

The family background holds a demonstrated part in the probability to create one's business, but many entrepreneurs do not have this background, and another advanced approach based on the identification of entrepreneurial fitness and skills does not make it possible to predict the occurrence of the phenomenon or the actor's identity. A certain number of authors emphasize the part to be played by the educational system in the promotion of an "enterprising spirit" prior to a business setting up intention (Frugie *et al* 2003).

Policy makers believe that increased levels of entrepreneurship can be attained through education and especially entrepreneurship education. Several authors, such as Raijman (2001) and Askun and Yildirim (2011) defend that education, by providing broad skills, training and knowledge facilitates the access to the business world through enabling individuals to assess the extent of the labor market, and the kind of goods customers demand, and to organize a business. For Carayannis, Evans and Hanson (2003) "there is no doubt that entrepreneurship education seeks to build knowledge and skills and also increases the likelihood of entrepreneurial success". Furthermore, Souitaris, Zerbini and Al-Laham (2007) and von Graevenitz, Harhoff and Weber (2010) added that entrepreneurship education increases the intention to start a new business. Hence, such education is promoted and implemented into school curricula in many of the European member countries and the United States. A key assumption underlying these programs is that entrepreneurship skills can be taught and are not fixed personal characteristics. Indeed, it has been shown that (1) the effect of general education as measured in years of schooling on entrepreneur performance is positive and (2) the business training is effective or the performance of people who applied for microfinance to start their own business (Oosterbeek, Van Praag and Ijsselstein 2010).

Promoting entrepreneurship is a key opportunity in the current environment, and engineering have recognized this criticism by including in their curricula basic financial disciplines, including cost analysis, economic evaluation of projects and economic engineering. The technical component of engineering expertise has been extended to non-technical components such as training in business.

3. Data collection and analysis

This paper presents the preliminary results from a survey designed to understand the entrepreneurial intentions of engineering students with no experience on entrepreneurship courses. The survey, named by ENGEmpreende, was applied to students of engineering courses from University of Minho who were approached in their classes and asked to participate in the research. Our sample has a total of 387 respondents, divided into undergraduate (78.55%) or master's degree students in engineering (21.45%). The gender distribution reflects the male domain among engineering students (60.47% males and 39.53% female) with a mean age of 22.26 years and a standard deviation of 5.036 years (range from 17 to 50 years).

Our study begins by asking the respondents about the entrepreneurial behavior of their parents (Laspita *et al* 2012). Figure 1 presents answers: 54.01% of respondents admit that their parents were never entrepreneurs against 45.73% who reported that parents have or have had a business (31.78% of respondents indicate that the business is still active, 9.30% that has been over for more than five years and 4.65% that the business has ended but still was active until 5 years ago).

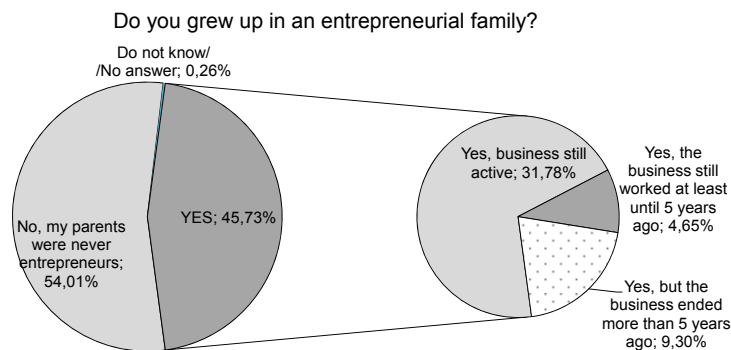


Figure 1: Entrepreneurial behavior of their parents

Based on these answers we created a new variable that measures parents self-employed by coding the “yes” answers as 1-yes; otherwise 0-no.

For the entrepreneur's intention, we adapted the question from Laspita *et al* (2012) and asked respondents if “*Have you ever considered seriously start your own business?*” Interestingly, 33.25% said they never thought about it. Yet the answers are mostly positive (total 65.98%) with 45.27% of respondents who are determined to be your own boss, even though 15.86% admit they have given up (see Figure 2).

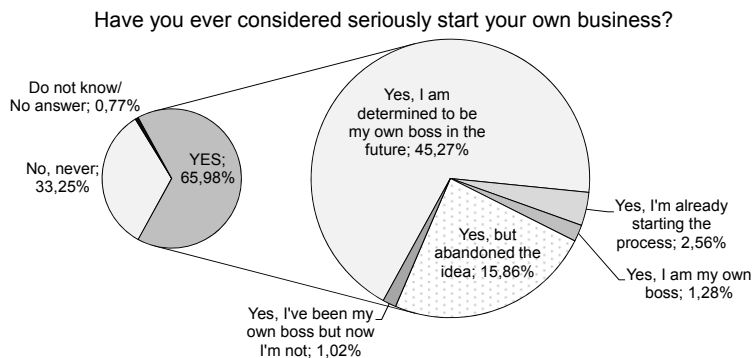


Figure 2: Entrepreneur's intention

Following Laspita *et al* (2012) we defined two new measures: (1) the thoughts about entrepreneurship coded the positive answers as 1-yes; otherwise 0-no, and (2) the entrepreneurial activities were answers “yes, I’m already starting the process”, “Yes, I am my own boss” e “Yes, I’ve been my own boss but now I’m not” were coded as 1-yes; otherwise 0-no.

The following is an exploratory analysis of student responses to several statements concerning entrepreneurship predisposition, attitude to self-employment, entrepreneurial image, barriers to entrepreneurship, risk perception and technical confidence. The methodology used tests the response to each item / statement and the answer to characterization questions such as gender, age, type of course (undergraduate degree or master's degree), year of course, parents self-employed, thoughts about entrepreneurship and entrepreneurial activities. [Note: the variable age was transformed into four categories according to age quartiles].

To know the *entrepreneurship predisposition* of engineering students we asked them: “*Suppose you unexpectedly inherit 20,000 euros. How would you invest this money?*” (Adapted from Rajjman, 2001). Surprisingly only 23.27% admits “*invest in a business of my own*”. The majority of respondents show little entrepreneurship willingness by choosing deposit in a bank account (33.76%) invest in a mutual fund (27.37%), invest in a car or house (7.65%) or even other (6.91%). Only 1.02% do “not know or not answer” the question.

We founded dependency relationships for entrepreneurship predisposition and gender ($\chi^2 (4) = 8,659$, $p < 0.10$), age ($\chi^2 (12) = 28,682$, $p < 0.01$), thoughts about entrepreneurship ($\chi^2 (4) = 27,741$, $p < 0.01$) and entrepreneurial activities ($\chi^2 (4) = 9,496$, $p < 0.10$).

The Figure 3 illustrates the distribution of results considering respondents thoughts about entrepreneurship. Respondents that never thought about entrepreneurship admit deposit the money in a bank account (47.69%). In turn, respondents with thoughts about entrepreneurship admit invest in a business (30.23%) or invest in an investment fund (28.68%).

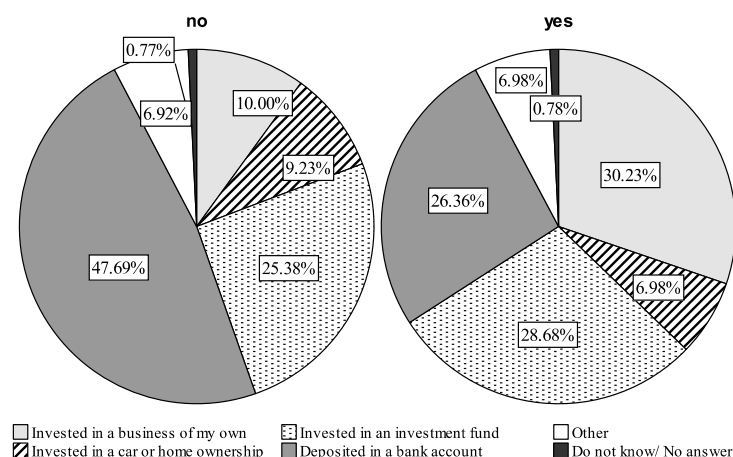


Figure 3: Predisposition and thoughts about entrepreneurship

The attitude towards self-employment considered three items adapted from Kuckertz and Wagner (2010) (Likert scale of agreement with five levels). The analysis of positive responses (“*I agree somehow*” or “*I totally agree*”) shows percentages below 50% which suggests low levels of attitude towards self-employment (see Figure 4).

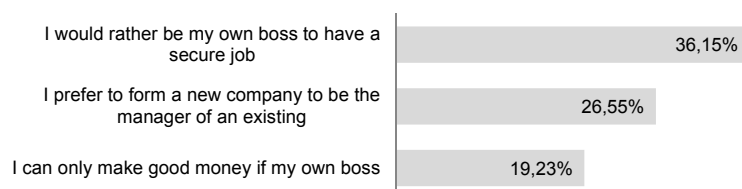


Figure 4: Attitude towards self-employment (% positive answers)

Concerning attitude items, we have found the following dependency relationships:

- The statement “I prefer to form a new company ...” displays dependency relationships with gender ($\chi^2 (4) = 21,560$, $p < 0.01$), year course ($\chi^2 (12) = 34,537$, $p < 0.01$), thoughts about

entrepreneurship ($\chi^2 (4) = 28,382$, $p < 0.01$) and entrepreneurial activities ($\chi^2 (4) = 11,291$, $p < 0.05$);

- In turn, "I can only make good money if ..." has dependency relationships with gender ($\chi^2 (4) = 8,604$, $p < 0.10$), course type ($\chi^2 (4) = 8,362$, $p < 0.10$) and thoughts about entrepreneurship ($\chi^2 (4) = 12,109$, $p < 0.05$);
- Finally, "I would rather be my own boss ..." shows dependency relationships with parents self-employed ($\chi^2 (4) = 9,190$, $p < 0.10$) and thoughts about entrepreneurship ($\chi^2 (4) = 25,952$, $p < 0.01$).

To measure the perceived image of the entrepreneur we adapted six items from Carayannis, Evans and Hanson (2003) and one item from Kuckertz and Wagner (2010) (Likert scale with 5 levels of agreement). The statements with higher positive answers were "*entrepreneurs have a positive image...*" (62.92%) and "*in business, it is preferable to be an entrepreneur than an employee in...*" (40.51%) (see Figure 5). The results suggest that students recognize the positive image of the entrepreneur in society, but have doubts about what is best (entrepreneur or employee in a large company). The results for "luck" (26.36%) and "*the training is more important than the personality...*" (21.74%) may suggest that students perceived the effort of the entrepreneur (not "luck") but assume personality a higher determinant to success than training (one interesting result for engineering students). The claims with lower agreement were respectively "*entrepreneurship is basically a resource for...*" (4.38%) and "*entrepreneurs are egotistical*" (9.04%).

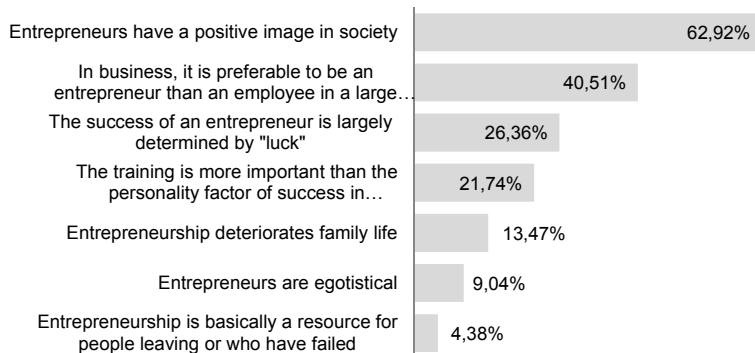


Figure 5: The perceived image of the entrepreneur

In order to explore possible differences in the responses, we decided to perform an analysis of the average profile as a function of the variables gender and thoughts about entrepreneurship (see Figure 6). The visual analysis of the chart it can be concluded:

- The male respondents tend to have higher levels than the average response of female respondents;
- When considering the thoughts about entrepreneurship, the average response profiles differ slightly: respondents with thoughts tend to agree more in positive statements (for example "in business, it is preferable to be an entrepreneur than ...") and to disagree more in negative statement (e.g. "entrepreneurship is basically a resource ...").

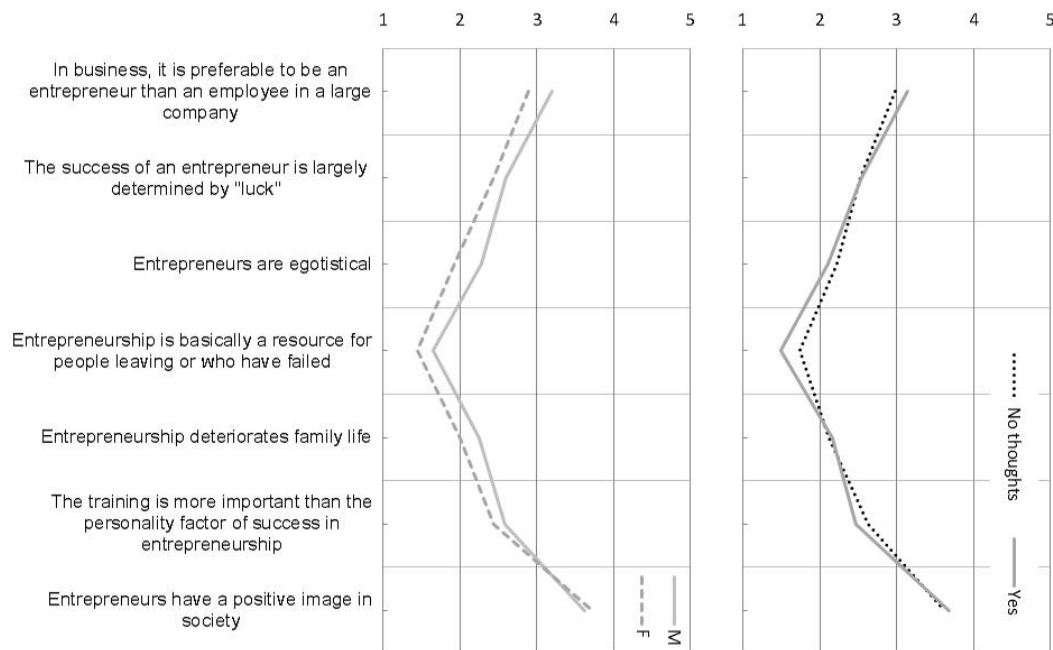


Figure 6: Mean profile according to the perceived image

For the perceived image of the entrepreneur, we test differences between the means with the variables gender and thoughts about entrepreneurship (t tests, independent samples). For gender there was a significant differences ($p < 0.10$) in all evaluation items except the two claims "*the training is more important ...*" and "*entrepreneurs have a positive image ...*". For the variable thoughts about entrepreneurship, we identified only one significant difference for "entrepreneurship is basically a resource..." ($p < 0.05$).

The entrepreneurship perceived barriers resulted from three items adapted from Kuckertz and Wagner (2010) (Likert scale of 5 levels of agreement). By analyzing the positive responses (see Figure 7) it appears that engineering students perceive as difficult to find a business idea (60.26%) or access to bank loans (55.27%). In relation to the adversity of law only 35.84% of respondents agree.

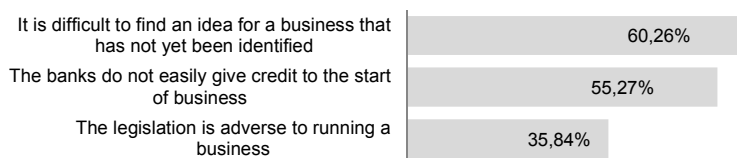


Figure 7: Entrepreneurship perceived barriers (% positive answers)

In exploring possible relations of dependence it was concluded:

- For the statement "*It is difficult to find an idea ...*" there were no relations of dependence;
- "*The banks do not easily give credit...*" depends only on the entrepreneurial activities ($\chi^2 (4) = 8,266$, $p < 0.10$);
- "*The legislation is adverse...*" depends only on gender ($\chi^2 (4) = 13,742$, $p < 0.01$).

To analyze the perceived risk we adapted three items from Carayannis, Evans and Hanson (2003) (Likert scale of 5 levels of agreement). Interesting to note that a significant proportion of respondents agree with "*I like challenges ...*" (74.94%) and "*start my own business is risky ...*". This duality reveals a taste for challenges that may not include the beginning of their own business since it is perceived as risky! This conclusion can be reinforced at the result obtained in the statement "*it is true we are our own boss, but ...*" with 49.87% of positive responses, suggesting that students may hesitate because they perceive the extra work and responsibility it entails (see Figure 8).

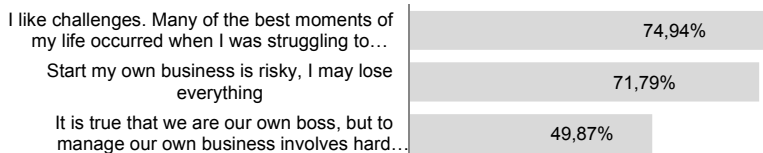


Figure 8: Perceived risk (% positive answers)

Regarding possible dependency relationships we found that:

- The statement "I like challenges ..." depends on the type of course ($\chi^2 (12) = 20,019$, $p < 0.10$), the thoughts about entrepreneurship ($\chi^2 (4) = 21,007$, $p < 0.01$) and entrepreneurial activities ($\chi^2 (4) = 11,539$, $p < 0.05$);
- "Start my own business is risky ..." it just depends on the entrepreneurial activities ($\chi^2 (4) = 12,714$, $p < 0.05$);
- There was no relationship of dependency for "it is true we are our own boss, but..."

Based on the work of Oosterbeek, Van Praag and Ijsselstein (2010) we defined a total of 10 statements (Likert scale of 5 levels of agreement) to capture the perceived skills and competence of the respondents. The analysis of the positive responses (Figure 9) suggests a perceived high adaptability ("*I adapt my plans ...*" with 79.49%), perseverance ("*I am always persevering ...*" with 74.81%), technical confidence ("*I am pretty confident about...*" with 67.96%) and orientation to results ("*I am extremely driven to achieve ...*" with 67.10%). The item with less agreement was "*I prefer other people to decide for me*" (9.49%) proposing respondents' independence. In turn, the item of financial skills ("*Financial services are complicated and confusing to me*") got only 29.38% of positive responses suggesting an interesting result for a sample of students. Unexpectedly, the item "*when I start something ...*" got only 38.72% of positive responses which reveals a breakdown in perceived trust.

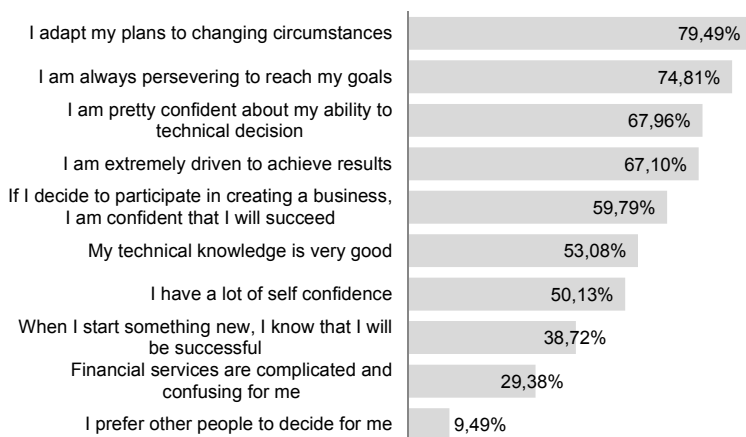


Figure 9: Perceived skills and competence

Considering our results, we decided to explore the average profile as a function of the variables gender and thoughts about entrepreneurship (see Figure 10). From the visual analysis of the chart it can be concluded:

- Male respondents have a higher statement concordance. We identify differences in four statements : "I am very confident about my ability...", "I have a lot of self-confidence", "If I decided to participate in creating ..." and "my technical knowledge is very good",
- Respondents who have thoughts about entrepreneurship show a profile of greater agreement. Differences are identified for "I have a lot of self-confidence" and "If I decided to participate in creating..."

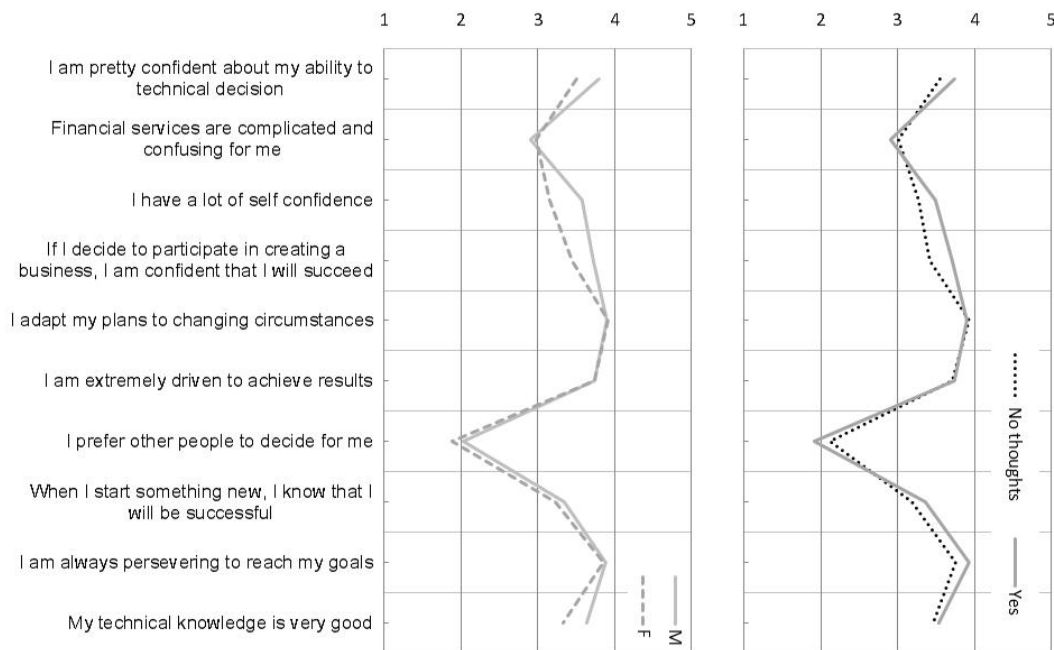


Figure 10: Mean profile according to the skills and competence

We also applied tests of differences of mean responses by gender and thoughts about entrepreneurship (t tests, independent samples). For gender we confirmed the four visually differences ($p < 0.01$). Once all claims are related to self-efficacy, it is possible to conclude that female students tend to have lower trust levels.

In turn, the variable thoughts about entrepreneurship presents significant differences (reference value of $p < 0.10$) in six items. The exceptions were the four statements: "*Financial services are complicated and confusing for me*", "*I adapt my plans ...*", "*I prefer other people to decide...*" and "*my technical knowledge is very good*". The results suggest that students who have thought in self-employment trend to be more confident.

4. Conclusions

The theme of entrepreneurship has been in prominent place on the political agenda of many countries. If by one side it is recognized its value and desirability to promote the economy, on the other hand the definition of incentive policies often do not produce the expected effects. Therefore, what predisposes someone to start your own business? Starting from the basic idea that engineering has the necessary expertise to develop and explore new ideas, and since the new curriculum include financial disciplines, our research aims to understand and analyze what values, attitudes and intentions the engineering students have.

Portuguese engineering students report good levels of thoughts about entrepreneurship. Nevertheless, when asked about money investment, a minority choose "*invest in a business of my own*". Our study found that their entrepreneurship predisposition has dependency relationships with gender, thoughts about entrepreneurship and entrepreneurial activities. Our study evaluate low levels of attitude towards self-employment for engineering students and identified dependency relationships with variables such gender, thoughts about entrepreneurship or parents self-employed or entrepreneurial. The results of the perceived image of the entrepreneur suggest that students recognize the positive image of the entrepreneur in society, but have doubts about what is best (entrepreneur or employee in a large company) (we identify differences for gender and thoughts about entrepreneurship). As perceived barriers, engineering students perceive as difficult to find a business idea or access to bank loans. The financing problem is the recognition of the Portuguese reality in which the bank remains the main source of funding, since there are no other organizations (venture capital, business angels ...) that can help enterprising individuals. Still, students indicate a taste for challenges that may not include the beginning of their own business (it is perceived as risky!) and suggest some hesitation due the perceived extra work and responsibility. The perceived risk answers suggested dependency with the entrepreneurial activities of the student. Students' perceived skills

and competence suggest a perceived high adaptability, perseverance, technical confidence and orientation to results. Nevertheless, and unexpectedly, they reveal a breakdown in perceived trust for the idea of being successful as entrepreneur. The results also suggest that engineering students do not anticipate problems in terms of its financial skills, which is a promising result!

The results presented are preliminary and require more careful analysis, as well as the need to be replicated in a larger sample. Still, our results are an important insight in terms of intention of entrepreneurship at the level of engineering students.

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